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INTEGRATION OF CONSIDERATIONS FOR FACILITIES MANAGEMENT IN DESIGN

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Abstract

One of the problems in the building industry is a limited degree of learning from experiences of use and operation of existing buildings. Development of professional Facilities Management (FM) can be seen as the missing link to bridge the gap between building operation and building design.

The paper identifies the aspects of FM that should be considered during the different stages of design. A typology of knowledge transfer from building operation to building design is presented and strategies, methods and barriers for transfer and integration of operational knowledge into the design process is discussed.

The paper is based on literature studies, case studies from the Nordic countries in Europe and research reflections on experiences from a major building project, where the author, before becoming a university researcher, was engaged as deputy project director in the client organisation with integration of considerations for Facilities Management as one of the areas of responsibility.

Keywords: Building Design, Facilities Management, Experiences, Design Management, Integration.

INTRODUCTION

The field of Facilities Management (FM) has evolved as a new profession and academic subject over the last 15-20 years in Northern Europe. It represents an increased awareness of the importance of the physical surroundings for the development of organisations. Compared to traditional building operation and maintenance (O&M), FM expresses a change in paradigm from a technical field with buildings as the main focus to a management field with the activities in buildings as the main focus, where buildings are regarded not as an end but as means to support the core business of an organisation. O&M is an important area within FM but the scope has become broader and includes the development of real estate and use of buildings in both short and long term as well as various support services. The need of the users and the user organisation is central to FM and decisions in the early stages of building projects are very important for professional FM.

One of the problems in the building industry is a limited degree of learning from experiences of use and operation of existing buildings. Development of professional FM can be seen as the missing link to bridge the gap between building operation and building design. Being responsible for the running cost, O&M, energy consumption, adaptation and development of the buildings belonging to an organisation, facilities managers has the daily contact with users and obtain an in depth knowledge about the special needs for facilities that support the processes and culture of that particular organisation. This knowledge can be a very valuable source to be used in the planning of new buildings if it is put into play in an appropriate way.

This paper identifies a number of aspects of FM that should be considered during the different stages of design and discusses strategies, methods and barriers for transfer and integration of knowledge from building operation into the design process. The paper is based on literature studies, cases studies in relation to FM in the Nordic Countries (Jensen et al, 2008) and research reflections on experiences from a major building project, where the author, before becoming a university researcher, was engaged as deputy project director in the client organisation with integration of considerations for Facilities Management as one of the areas of responsibility.

The paper starts with a literature review. Based on this a typology for knowledge transfer from building operation to building design is presented and different strategies and methods to transfer and integrate knowledge related to FM in design are discussed and a conclusion is drawn.

LITERATURE REVIEW

FM is a relatively new field of research and there is only a few studies concerning the integration of considerations in building design. There are also considerable variations in the definitions and understanding of FM. There have even been disagreements whether Facilities Management and Facility Management are two different things or the same. In 2006 a European standard with Terms and Definitions of FM was adopted (CEN, 2006). Besides stating that Facilities Management and Facility Management are synonyms, it gives the following definition of FM: "*The integration of processes within an organisation to maintain and develop the agreed services that support and improve the effectiveness of the core activities.*"

The idea of knowledge transfer from building operation to building design is far from being new. Bröchner (1996) reports experiments from Sweden in the 1960's, but these were less than satisfactory. Bröchner makes a re-evaluation based on expectations that the development in information technology should have made the knowledge transfer easier in the mid 1990's, but concludes that the necessary incentives were lacking. However, Bröchner is concerned about the feedback from building operation of a building to the design team responsible for designing that particular building. In comparison this paper is concerned with feed-forward from building operation of existing buildings to the design of new buildings.

Before the concept of FM was used, during the 1980's in Denmark, we experienced an increased interest in building operation and several projects were carried out to establish a more profound professional basis for building operation. One of these projects concerned planning of operational friendly buildings and it resulted in a recommendation for practitioners (BUR, 1985). The recommendation described what activities should be carried out in each phase of a typical building project and which party – building client, users, operational staff, designers, contractors and suppliers - should be responsible for each activity. A number of different tools to support the activities, including a specification of estimated lifetimes of typical building parts, were presented. In general the report represented an attempt to increase the awareness among designers of the need to take operational aspects into consideration in the design process, but it has had little practical impact on the practice of building design in Denmark.

BIFM (British Institute of Facilities Management) is by far the largest national FM-association in Europe and around year 2000 they commissioned a project to the Building Research Establishment (BRE) about bringing facilities expertise into the design process. This resulted in a report which analyzed why and when the facilities manager should be involved and contribute to the design process and why the facilities manager often is excluded from the design process (Jaunzens, 2001). The barriers for the involvement of the facilities managers were identified as a combination of the perception of the facilities managers within their own organisation and within the design team as well as the facilities manager's self-perception. The main problem seemed to be that facilities managers in general are not sufficiently qualified to be capable of and accepted as an equal dialogue partner in the design process. The report finishes with the description of a development plan for the facilities manager including recommendation for how to become empowered and a presentation of a self-assessment tool. In general the report expressed the viewpoint that the problem of facilities manager's limited contribution to the design process is related to a lack of the necessary competences and prestige.

Based on my experiences from working as a deputy project director in the building client organisation for a new headquarters called DR Byen (DR City) for Danish Broadcasting Corporation (DR) in Copenhagen and a study tour to England, which included a meeting with the main author of the BRE-report mentioned above, I wrote a book in Danish about building planning and FM (Jensen, 2002). In this I identified the most important FM-specific tasks in building planning as transfer of experiences from existing buildings, integration of considerations for operation and sustainability, requirements for documentation about the new building, considerations for user needs, planning and organisation of the coming building operation, and interior and move planning. This was further specified in relation to the different phases of a building project as shown in Table 1.

The most important task in table 1 in relation to design is the incorporation of consideration for operation, sustainability and user needs. The considerations for operation and sustainability include a vast number of aspects related to the whole life cycle of the building after construction. Among the most important are:

- Flexibility and adaptability in relation to changing needs over time
- Logistics in relation to internal communication, transport and distribution
- Ease of maintaining and cleaning the building and the surrounding areas
- Possibilities to replace and reuse building parts
- Safety and security of the building, persons and assets
- Energy and resource consumption (electricity, heating, cooling, water etc.)
- Environmental impact on the surroundings (pollution, noise, dirt)
- Indoor climate and working conditions
- Building management systems and installations

Building project phase	**FM-specific tasks**
Decision	Incorporating real estate strategies Information on space needs etc. Estimation of impacts on cost of FM
Briefing	Organisation of user involvement Formulation of considerations for operation and sustainability Overall requirements for documentation
Design	Incorporation of considerations for operation, sustainability and user needs Formulation of operational concept Formulation of requirements for building automation system
Construction	Interior planning Prepare commissioning Contracting-out operational tasks
Occupation	Move Handling former building(s) Implementation of operational procedures

Table 1: *FM-specific tasks in building project phases*

The consideration for user needs involves user involvement and follow-up on the building brief during design. A particular form of user needs is accessibility for the disabled and other users with special needs. I have at earlier architectural management conferences presented research papers on accessibility (Jensen, 2005) and user involvement and briefing (Jensen, 2006b). These aspects will not be dealt with further in this paper.

The experiences from DR Byen show that it is very important, that the building client takes on a leading role in defining and setting up requirements and procedures to make sure that the consideration for operation and sustainability is taken seriously by the design teams (there were 4 different design teams each responsible for a building in the 133.000 sqr.m development). Both the project director in the original client organisation and I had several years of experience from DR's internal FM-department and therefore these considerations had a high priority. One of my duties was being project manager for FM and there was also an environmental manager appointed in the client organisation. Furthermore, there were specialist consultants involved on the client side to review design documents in relation to these considerations.

In a recent book on design management Emmitt (2007) presents a learning perspective on how information from past projects and buildings can be utilized and integrated in the design process of new buildings. Emmitt stresses the possibility of using computer software to retrieve past project information quickly and writes: "Increased interest in both building and service maintenance, coincident with the growth in the facilities management discipline, has brought a greater awareness of the value of accurate, accessible information."

Lê (2007) also presents a learning perspective in a conceptual research paper based on a PhD-study in Norway. The study concerns so-called multi-project building environments, which are companies who both are involved as building clients in new building projects and responsible for O&M of existing building. The focus is on the relation between individual learning, which is mostly related to tacit knowledge, and organizational learning, which is mostly related to explicit knowledge. Lê presents an integrated organisation-learning model that combines individual and organizational learning and involves developing individual mental models into shared mental models. From the organisation-learning model Lê identifies 7 different learning breakdowns and relates these to the building industry. An overview with brief examples of applications to the building industry is shown in table 2.

Incomplete learning cycles	**Application to the building industry**
Role constraint learning	Few demanding customers, many participants with varying roles from project to project and fierce price competition.
Audience learning	Project participant's learning has no effect on organizational action, the organisation or the building industry
Superstitious learning	Characteristics of production by orders that go into a relatively complicated "assembly process"
Learning under ambiguity	Not many participants have ownership or financial interest in the whole production chain
Situational learning	Ad hoc organisations result in individually based and not organizational based experience transfer
Fragmented learning	Difficult to discern differences between the operational work task and the designer's work tasks
Opportunistic learning	Almost no systemized and continuous learning process from project to project due to knowledge transfer

Table 2*: Learning breakdowns linked to the building industry (Extracts from Lê, 2007)*

Lê mentions two general strategic approaches to organizational knowledge management: The codification strategy (technology focused) and the personalization strategy (expert focused). The first strategy relies on employing information technology and data base systems as repositories of organizational knowledge and as a medium of communications, while the personalization strategy depends on interpersonal contacts. Experience transfer is a special type of organizational learning that is influenced by both technical and social factors, but which is particularly sensitive to informal organizational conditions.

A TYPOLOGY OF KNOWLEDGE TRANSFER

Based on the literature a number of different mechanisms of knowledge transfer from building operation to building design can be identified. Overall a differentiation can be made between knowledge push from building operation and knowledge pull from the design process. The strategies presented by Lê of codification and personalization can be seen as knowledge push from building operation. The BUR-report focuses on codification of knowledge for building operation, for instance lifetime expectancy of building materials, but also to increase the awareness among designers of the need to integrate considerations for building operation in building design. The BRE-report focuses on competences among facilities managers and their prestige in the design team, which seems to be related to a personalization strategy of knowledge push from building operation. Emmitt focuses on an increased awareness among designers to get access to information from past projects and the experiences from DR Byen emphasized the need for the client to use his power to ensure that considerations for building operation is integrated in the design process. These different mechanisms can be organized in a matrix as shown in table 3, which provides a typology of 4 generic mechanisms for knowledge transfer.

<table>
<tr><td colspan="2"></td><td colspan="2">Knowledge pull
from building design</td></tr>
<tr><td colspan="2"></td><td>Awareness</td><td>Power</td></tr>
<tr><td rowspan="2">Knowledge push
from building operation</td><td>Codification</td><td>1
Lê, BUR, Emmitt</td><td>4
State regulations</td></tr>
<tr><td>Competences</td><td>2
Lê, BRE, DR Byen</td><td>3
BRE, DR Byen</td></tr>
</table>

Table 3*: Typology of mechanisms for knowledge transfer with examples*

The typology results in the following four mechanisms:

1. Codification of knowledge from building operation, which can increase the awareness among designers. Examples of this are represented by Lê, BUR and Emmitt.

2. Competences among facilities managers, which can increase the awareness among designers. Examples of this are represented by Lê, BRE and DR Byen

3. Power to ensure that designers take considerations for building operation seriously by using the competences of facilities managers. Examples of this are represented indirectly by BRE and DR Byen.

4. Power to ensure that codified knowledge from building operation are used by the design team. There are no examples of this in the literature presented earlier, but an example is that the state in Denmark has specified that all state supported building projects must include calculations of life cycle costs.

DISCUSSION OF KNOWLEDGE TRANSFER

Importance and limitation of power

The typology above shows principally different mechanisms for knowledge transfer from building operation to building design. It could be anticipated that the mechanisms involving power would be the most effective mechanism, but that is not necessarily the case. The experiences with the requirements for life cycle costing in Danish building projects have shown that the effect is limited. If the calculations are made, they are often only a superficial exercise without much real effect on the design (Bjørberg and Haugbølle, 2005). Power can on the other side be very important, particularly when it is combined with competences and codified knowledge. The few experiences so far with building projects in Public-Private-Partnerships (PPP) in Denmark show that this organisation changes the power relations among the involved parties. The FM-provider in the consortium can obtain real influence on design solutions by using their experiences supported by calculations of life cycle costs. In PPP-consortiums the FM-provider becomes an equal or even a dominating partner in relation to the design team and is capable of enforcing decisions that are beneficial of considerations for building operation (Jensen et al, 2008).

Hence, the organisation of the building project has very strong impact on the power relations between the parties involved in design. In recent years, due to the increased importance of FM, there has been a change in the relation between FM and building client functions in large corporations – at least in the Nordic countries. Earlier the building client function often was an independent department with responsibility for a major investment budget. Today the building client function is often part of a comprehensive FM-department (Jensen et al, 2008). This has led to a much stronger focus on taking a more holistic view on building projects, including increased focus on the considerations for building operation in design. However, there are a lot of different considerations behind the way building projects are organized and the consideration for building operation are not always among the top priorities. Even so, the development has in general increased both the competences and awareness among building clients on the need to take considerations for building operation into account.

Motivation and competences of the designers

In relation to the design team the power aspects can be important for the awareness, when the client sets up specific requirements for considering building operation in the design. This gives an external motivation to the designers. The internal motivation is perhaps the most important factor for the considerations for building operation to be taken really seriously. The internal motivation is very much dependent on the competences of the designers and the policies of the design companies. In Denmark all the major consulting engineering companies has departments for FM consultancy, but these departments are not usually involved in building design unless the building client is willing to pay for this as an extra service. There are also architect firms that are beginning to establish similar FM related units but on a much smaller scale as the architect firms generally are much smaller. Futhermore, FM is increasingly becoming part of the curricula for architectural technologists and engineers, but not so much for the academic architects. The possibilities to follow further education courses are also increasing. The general result is that both the awareness and competences among designers is slowly increasing.

Involvement of FM expertise

A common attempt to integrate considerations for building operation is to directly involve facilities managers with a background of building operation in the building design process. This can take the form of participation in various types of design meetings like workshops or reviews. The effect of this is often limited due to the inadequate competences of the staff in building operation and their prestige in the design team as discussed in the BRE-report. The staff in building operation usually has a background as skilled craftsmen or technicians with a mostly practical education. These people are used to learning from doing in a situational context rather than based on a theoretical understanding and their knowledge is to a high degree tacit. The ability to transfer their knowledge from the concrete context of existing buildings to the abstract context of building design is limited. Furthermore, their insight in the design process is limited as well, and therefore they often will contribute with comments at the wrong time and in an inadequate way seen from the designers' point of view. As the designers are in charge of the process, they tend to ignore or patronize the staff from building operation. The obvious way out of this situation is that the facilities managers involved in building design needs to have more adequate competences. This means a more theoretical and abstract educational background and an insight in the building design process.

Other ways of involving FM in building design is the use of specialist consultants and/or involving specialists from FM providers. Both these possibilities are valid, but mostly in relation to special problems areas or participating in reviews at specific points of time. The ongoing involvement of FM is best placed in the FM function that will be responsible for the building after construction as they need to know the building and influence the design from their knowledge of the needs of the client organisation and the end users.

Codification of knowledge

The codification of knowledge from building operation can take on many different forms. Many FM organisations have Computer Aided FM systems (CAFM) and Building Management systems (BMS), which collects information from building operation on a continuous basis. This information can give valuable information on issues like space utilization, operational cost (maintenance, cleaning etc.) and energy consumption. Many modern systems can generate key figures based on historical data. In several European countries benchmarking associations or clubs have been established in relation to research institutions or consulting companies, which collect operational data from the associated corporations and generate common average key figures to be used in the corporations for benchmarking and developing their FM processes. EuroFM has produced a report that compares such benchmarking systems in six European countries (EuroFM, 2001). These kinds of operational key figures are very useful for budgeting operational cost and calculating life cycle cost when deciding and developing new building project. However, there is a vast amount of unutilized data in FM systems, which could be useful, if the necessary resources were available for retrieval, analyzing and codifying the data. This is an important and mostly unexploited source for research.

One of the promising developments in relation to reuse and codification of data is the introduction of comprehensive Building Information Models (BIM), which successively creates an object based 3D-model of a building during the design process with the possibility to attribute all sorts of information to the objects and generate views and extract report for all the needs in both design, construction and building operation. One of the barriers so far has been a lack of interoperability across different systems. The National Institute of Standards and Technology in USA has published a report which estimates the annual cost of lacking interoperability in the US capital facilities industry as $15,8 billion (Gallaher et al, 2004). However, the international exchange format IFC is becoming more and more accepted. Recently the state administrations in Denmark, Norway and Finland have made an agreement with the General Service Administration in USA to collaborate in the development of IFC as a common international standard.

In Denmark the state has supported the digital development in building design and FM by specifying requirements for digital tendering, use of project-web, 3D design and digital handover of building documentation to building operation, which all state building projects must comply to (National Agency for Entreprise and Construction, 2005). The digital handover is of particular interest to FM (Jensen, 2006a). However, it represents transfer of information from building design to building operation and not the other way around. A vision for the future development is that it will be possible to generate briefing information from BIM based on an ongoing update of experiences from the operation of existing buildings.

CONCLUSION

The question of knowledge transfer from building operation to building design can be seen both as knowledge push from building operation and as knowledge pull from building design. Seen from the knowledge push perspective the knowledge transfer is dependent on codification of knowledge from building operation and competences among facilities managers, while seen from the knowledge pull perspective it is dependent on the awareness and competences among designers and building clients and the amount of power behind the requirements to take considerations for building operation into account.

There seems to be a positive development on the way, that supports an increased knowledge transfer, but it depends a lot on the organisation of the individual project and the competences of the parties involved in the project. The increasing number of key figures on building generated by CAFM, BMS and benchmarking systems represents a higher degree of codification of operational knowledge and the development of BIM is promising for the possibilities to reuse data in the whole building life cycle. In the future development it may be possible to generate briefing information from BIM based on an ongoing update of experiences from the operation of existing building

LITERATURE

Bjørberg S. and Haugbølle K. (eds.) (2005): *LCC for byggverk. Nordisk hovedprosjekt – sluttrapport (LCC for Buildings and Constructions. Nordic main project - final report)* (In Danish, Swedish and Norwegian with summary in English). Danish Building Research Institute, SBi, Hørsholm.

Bröchner, J. (1996): *Feedback for Facilities Management to Design and Construction – Systems Issues.* In Langford, A. and Retik, D.A. (Eds): *The Organization and Management of Construction,* Vol. 3, Taylor & Francis, London, pp. 238-46.

Byggeriets Udviklingsråd (2005): *Planlægning af driftsvenligt byggeri – en anvisning.* (The Construction Development Council: *Planning of operational friendly buildings*). Copenhagen, 1985.

CEN (2006): *Facilities Management – Part 1: Terms and definitions.* European standard EN 15221-1.

Emmitt, S. (2007) *Design Management for Architects.* Blackwell Publishing.

EuroFM (2001): *Facilities Management Benchmarking in Europe - A comparative Study of FM Benchmarking in Six European Countries.* EuroFM Report.

Gallaher, M.P., O'Connor, A., Dettbarn, J.L. and Gilday, L.T. (2004): Cost Analysis of Inadequate Interoperability in the U.S. Capital Facilities Industry, NIST GCR 04-867 (http://www.bfrl.nist.gov/oae/publications/gcrs.html).

Jaunzens, D., Warriner, D., Garner, U. and Waterman, A. (2001): *Applying facilities expertise in building design.* Building Research Establishment.

Jensen, P.A. (2002): *Byggeri – fra vision til ny virkelighed. (Building – from vision to a new reality). Forlaget Tegl, 2002.*

Jensen, P.A. (2005): *Designing for Disability – A Danish Case Study on DR Byen.* In Proceedings of CIB W096 Architectural Management. BYG-DTU.

Jensen, P.A. (2006a): *Digital Handover of Data from Building Projects to Building Operation.* In Proceedings of European Facilities Management Conference 2006. Frankfurt.

Jensen, P.A. (2006b): *Continuous Briefing and User Participation in Building*

Projects. In Proceedings of CIB W096 Architectural Management. University of Technology. Eindhoven.
Jensen P.A., Nielsen, K. and Nielsen, S.B. (2008): *Facilities Management Best Practice in the Nordic Countries – 36 cases*. Book in English. Centre for Facilities Management – Realdania Research, DTU Management Engineering (see www.cfm.dtu.dk).
Lê, M.A.T. (2007): *Linking experience and learning: application to multi-project building environments.* Engineering, Construction and Architectural Management, Vol. 14 No. 2, 2007, pp. 150-163. Emerald Group Publishing Limited.
National Agency for Entreprise and Construction (2005): *Digital Construction.* Brochure. March 2005. (http://www.ebst.dk/file/3095/digitalconstruction_intro).